Thermal Spectrum for Nuclear Waste Burning and Energy Production

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The private sector has been the primary source of world-changing innovation for most areas of new technology development in the U. S for the past 50 years. We report here new options developed without government funding that extend the original Los Alamos ATW initiative and might offer a resolution to the problems of nuclear energy that government management has not been able to solve for decades.

Continuous-flow molten-salt thermal-spectrum systems

Several of our papers in refereed journals describe how continuous fuel flow eliminates the need for refueling downtime, enables breeding with the same effectiveness as fast spectrum reactors without reprocessing and fuel refabrication, eliminates the need for enrichment of any kind, and accomplishes the burning of existing spent fuel in a much shorter time scale and with much lower inventory and therefore many fewer systems than is possible with fast spectrum systems.

Supplemental neutrons from deuterium gas targets

We are exploring a new accelerator target that might provide neutrons at the same energy cost as spallation but with the advantages of much lower accelerator energy and the elimination of spallation products. A 100-MeV proton beam directed upon a deuterium gas target would collide with the deuterium to produce neutrons, fast moving deuterium ions that produce more neutrons by (d,d) reactions and also forward-moving fast tritium or 3He ions that produce even more neutrons and deuterons. The total process initiated is a forward directed cascade of all of the fusion reactions producing fast neutrons that may be multiplied by a surrounding blanket of Be or Pb

Tailoring the thermal spectrum using graphite manufactured with lattice-stored energy

Our efforts to understand anomalous neutron transport observed in experiments with large amounts of bulk granular graphite show that stored energy can be built into newly manufactured graphite. Neutrons moving through the graphite tap this energy with the result that the neutron spectrum from room temperature graphite can be adjusted from the expected 25 meV to 250 meV depending on the graphite production process. This change in spectrum by a factor of three in average neutron velocity implies 50–100% increases in the reaction rates for many nuclides of interest including ^{237}Np, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{241}Am, and ^{249}Cf and lower absorption by three for graphite moderators and reflectors.

Fusion for neutron production instead of energy production

The ultimate purpose of reprocessing is to eliminate the waste of scarce neutrons on unproductive absorption. However reprocessing is proliferation-prone and has been found to be much more expensive than expected. It might be more economically practical to lose some neutrons wastefully and eliminate reprocessing if the cost of supplemental neutrons is low enough. It can be shown that long before fusion systems produce energy at costs competitive to fission, they will produce neutrons at a cost much lower than accelerators and thereby probably make practical subcritical systems with k_{eff} perhaps as low as 0.50.

This paper calls for new effort in accelerator targets, molten salt technology, new graphite-based thermal-spectrum systems optimized to take maximum advantage of neutron spectrum control by stored-energy graphite, and new fusion research aimed at copious neutron production instead of economic fusion power. Pursuit of the advances presented here should enable a breakout of fission energy technology from present U. S. policy for incremental improvement to mature technology that has been economically and/or politically undeployable in this country and the world for decades. A list of nuclear data requirements will be included.

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